Alternatives to Methyl bromide in Strawberries and Peaches

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Strawberry production in California relies heavily on preplant soil fumigation with methyl bromide (MB). Strawberries grown in fumigated soil have considerably higher yields than berries grown in nonfumigated soil. The reason for the fumigation response is unknown, but is believed to be due to control of minor pathogens or detrimental soil microorganisms. Peach production also depends on methyl bromide fumigation to control peach replant disorder. In these case also, the pathogens involved with the problem are not known. Since MB has been classified as a chemical that contributes to depletion of the Earth's ozone layer, production and importation of MB in the United States are scheduled to be phased out by 2005, with only critical agricultural uses allowed after 2005. Currently, there is no single chemical alternative to methyl bromide for preplant soil fumigation use.

The objective of this research was to develop and integrated approach to alternatives to MB, using chemicals and biologicals, such as Plant Growth Promoting Rhizobacteria.

Plant Growth Promoting Rhizobacteria (PGPR) are bacteria which live on the roots of plants and enhance plant growth. The mechanism is not known. Approximately 130 isolates were provided by Gustafson and screened over 3 years.

The PGPR isolates were screened in small plot and greenhouse trials on strawberries, peaches and, and candidate strains were tested in advanced trials with larger plots at Fresno and Parlier, CA. Bacteria were grown on Tryptic soy broth for 3 days to induce endospore formation. The cells were centrifuged and resuspended in 0.6% sodium alginate and stored in the refrigerator. At planting, the concentrated bacterial suspensions were further diluted with 0.6% alginate and plant roots were dipped into the suspension immediately before planting. Final concentration was generally 10^7 cfu/ml.

To avoid cross contamination, workers wore and changed gloves between treatments. Plants were carried in plastic boxes with liners. Liners were discarded and the boxes cleaned with 70% alcohol between treatments.

In Fresno, strawberries were planted in August and harvested the following spring from late April to early June. In Salinas, planting occurred in early November, harvest

began in April and continued to September. Yield data were collected and are summarized here. PGPR were also tested on peach seedlings in the greenhouse.

Testing began by screening strains in small plots at Parlier, CA. The top few strains were tested in larger plots in the advanced trial the following year. As small plot screening trials continued, the top strains from previous years were included as a high control. In all 130 strains were screened. To determine if performance of the strains differed in fumigated soil, strains that did well in the advanced trials were included as subplot treatments in chemical trials.

Strains that consistently did well were included in trials in Salinas, CA and were used in combination with chloropicrin (pic) fumigation as well as MB and methyl iodide (MI) fumigation, and in non-fumigated plots. PGPR were applied at planting, after the fumigant had dissipated.

This combination of soil fumigation with chloropicrin, followed by PGPR applications to plant roots at time of transplant, has produced very good yields. In the most recent Salinas trial, use of strain A8C59, in chloropicrin fumigated soil, yielded as well as MB or MI fumigation alone. Results showed both MI and CP treatment fumigation significantly increased strawberry yield as compared to nontreated control plots, and that MI and MB did not differ significantly.

This work demonstrates that strawberries and peaches respond to PGPR. The two of the best strains identified for strawberries are Auburn strain 90-166, *Serratia marcescens*, and Ecoscience strain A8C59, *Pseudomonas putida*. Additional Gustafson strains of *Bacillus sp.* performed well in the most recent screening trial and will undergo further testing.

This integrated approach is advantageous because it does not require a major change in the cropping system. PGPR lend themselves to application through the drip irrigation system, and chloropicrin is already in use in combination with MB. Little or no addition equipment is needed since many growers already apply fertilizer through the irrigation system. Some chemical alternatives require a long waiting period between crops, resulting in loss of yield and revenue. This integrated approach will not require a major change in the cropping system. Strawberry yields achieved with this combination of treatments approach or equal those achieved with methyl bromide.